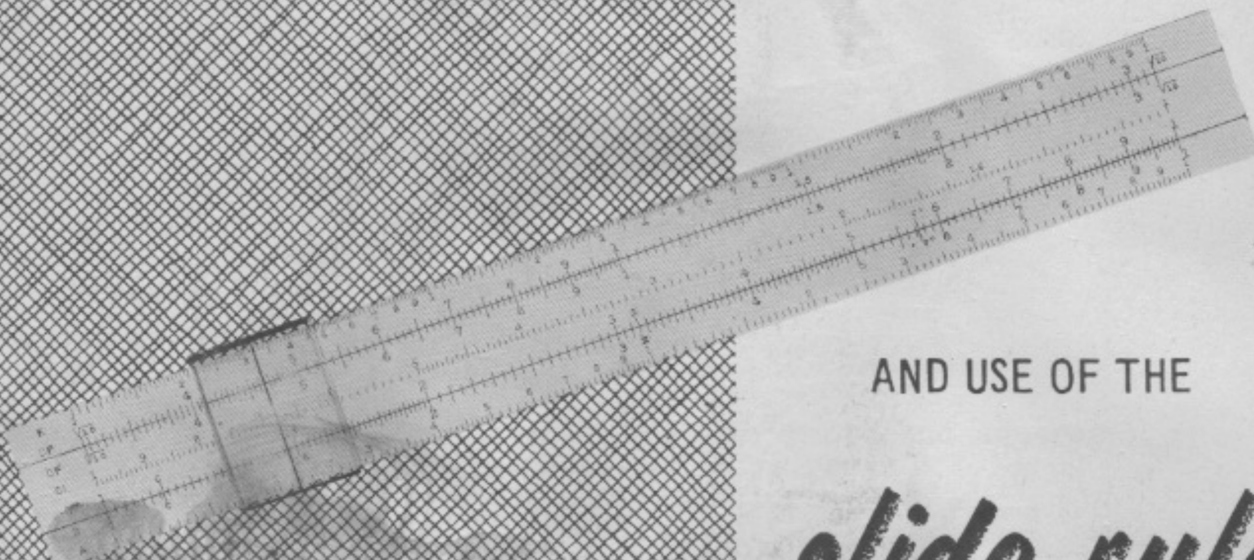
the theory



AND USE OF THE

slide rule

BY

BENJAMIN BOLD
CHAIRMAN OF MATHEMATICS DEPT.
SEWARD PARK HIGH SCHOOL
NEW YORK CITY, N.Y.

EDITED BY: THOMAS C. O'BRIEN
INSTRUCTOR, DEPT. OF MATHEMATICS
IONA COLLEGE
NEW ROCHELLE, N.Y.

Price 50 cents

Table of Contents

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STEPHENS STAR CO.

THE THEORY AND USE OF THE SLIDE RULE

Chapter I - Introduction

This pamphlet is designed to give the reader an understanding of the basic principles upon which the operation of the slide rule depends as well as to increase his facility in performing mathematical calculations. All of the basic scales are explained and their use illustrated by numerous exercises that are explained step by step. A sufficient number of practice problems (with answers) are presented to enable the student to develop competency in the use of the rule. The problem material has been carefully selected from many fields----mathematics, physics, (including atomic energy and nuclear physics) and chemistry. The concepts which can be acquired through a careful study of this pamphlet should enable the student to make use of the full resources of the slide rule.

It has been said that the invention of logarithms has doubled the working life of an astronomer by reducing the time spent on computations. A logarithm can be considered as just another way of writing an exponent. From algebra you know that $2^3 \times 2^5 = 2^8$. Thus, to multiply 8 by 32 to obtain 256, we can add the exponents (of the base 2) 3 and 5, to obtain the exponent 8. Also, to divide 256 by 32 to obtain 8, we can subtract the exponent 5 from the exponent 8 to obtain the exponent 3 ($2^8 \div 2^5 = 2^3$).

In elementary mathematics 10 is used as the base of the logarithmic system. Given any two numbers, M and N, we can find two other numbers, a and b, so that $10^a = M$ and $10^b = N$.

In order to multiply M and N we can proceed as follows: $M \times N = 10^a \times 10^b = 10^{a+b}$ = Product of M. and N. Since we can write $10^a = M$ in the form $\log M = a$, the result can also be written as follows:

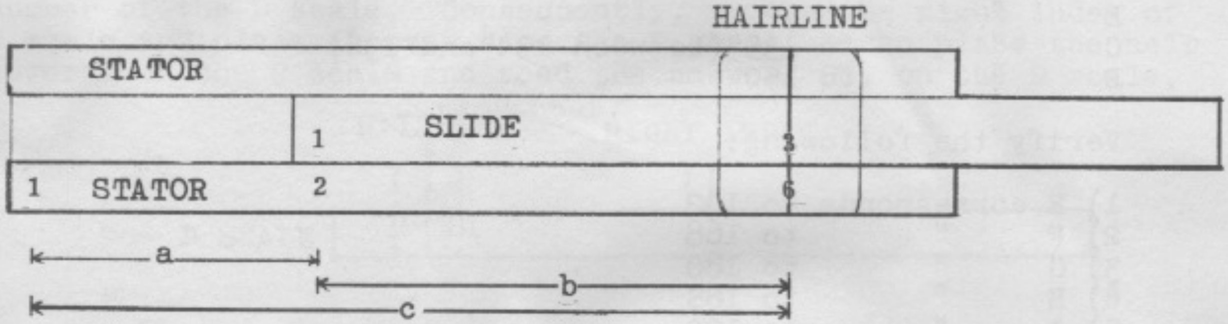
$$\log M = a \quad \text{and} \quad \log N = b$$

$$\log M + \log N = a + b = \log (MN).$$

The result tells us that to multiply two numbers, we add their logarithms. Similarly, to divide two numbers we subtract their logarithms.

A simple way to add two numbers such as 2 and 3 is to add two line segments of lengths 2 and 3. However, if instead of ordinary numbers we use logarithms, then $\log 2 + \log 3 = \log 6$. Basically that is what the slide rule accomplishes -- it enables us to add and subtract logarithms by adding and subtracting line segments.

The illustration shows that when the log 3 is added to the log 2 the result is log 6 (or 2 x 3 = 6). Segment length a represents log 2; segment b, log 3; and segment c, log 6.

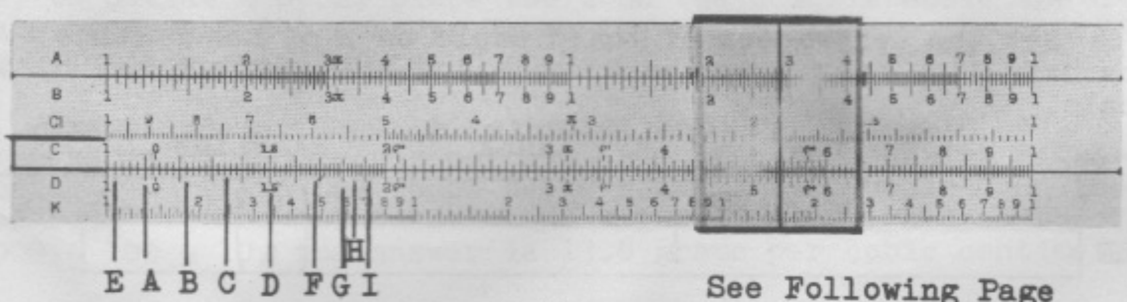


The reading of the different scales and their uses can easily be understood if we keep the above discussion in mind. The "D" scale, for instance, is a logarithmic scale. It starts with 1, really the log 1, which equals 0. Furthermore, the interval between successive integers diminishes. Thus, if you add the interval from 1 to 2 to the interval from 1 to 3, you obtain the interval from 1 to 6 (log 2 + log 3 = log 6). The slide and stator do the addition and subtraction, and the hair line helps us read the scales accurately.

With a little care and practice, you can learn to use the slide rule with great precision. The slide rule is a great time saver, not only for astronomers, but for any one who uses mathematics. It can be of great help in science, engineering, business and industry. The time spent in learning the use of the slide rule correctly is repaid many times over by the time saved in performing mathematical calculations.

Chapter II - The C and D Scales

The most frequently used scales are the C scale (on the slide) and the D scale (on the stator). Since the lengths between integral units progressively diminish, the intervals between 1 and 2, 2 and 3, etc. are not divided in the same way. The interval from 1 to 2 on your slide rule is divided into 10 major parts, each equal to .1 of the interval. Each major division is divided into 5 parts. Therefore each division is 1/5 X .1 = .02 of the interval. The same analysis can be used to find the value of a division for any other interval.



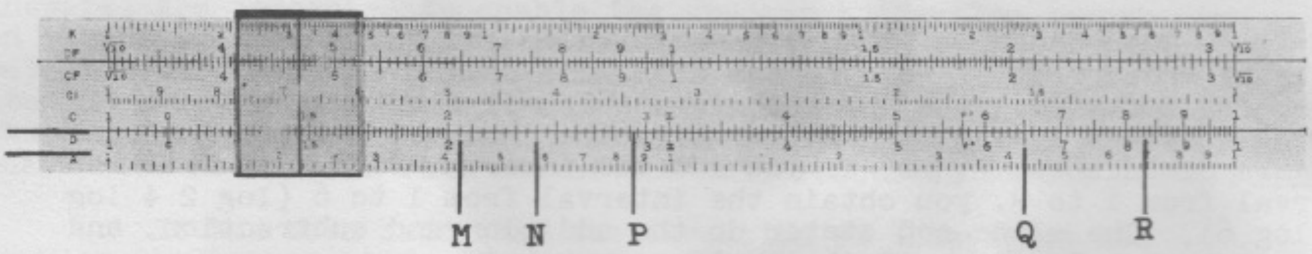
See Following Page

Omitting any reference to decimal points (which, of course, must be located by the one using the rule), we can see that

A corresponds to 110
B " to 122
C " to 135 (between 134 and 136)
D " to 150

Verify the following:

1) E corresponds to 102
2) F " to 168
3) G " to 180
4) H " to 185
5) I " to 192



M corresponds to 205, since there are 10 main divisions and each one is divided in half.

N corresponds to 240
P " to 292 (between 290 and 295)
Q " to 650 (since there are just 10 divisions that are not subdivided.)
R " to 830

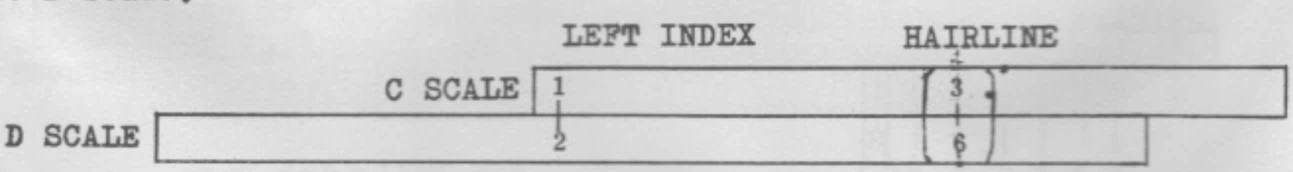
The intervals between 3 and 4, 4 and 5, 5 and 6 on many rules are subdivided in the same way as the interval between 2 and 3, but we must keep in mind that the lengths of the intervals are not the same.

Notice that you can obtain at most three digit accuracy with this slide rule.

The C and D scales can be used to solve problems involving multiplication and division.

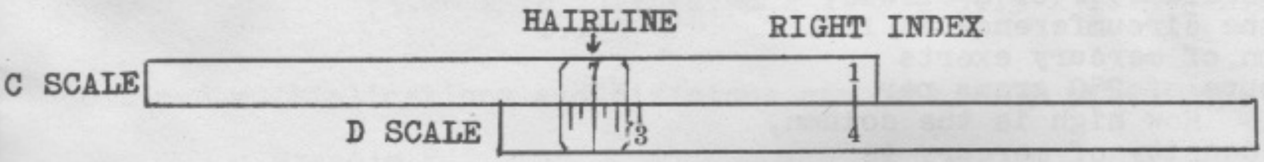
Example I. Multiply: 2 x 3

Set the left index of the C scale on 2 of the D scale. Place the hair line over 3 on the C scale and read the answer, 6, on the D scale.



Example 2. Multiply: 4×7

If we set the left index of the C scale over 4 on the D scale, 7 on the C scale will be too far to the right to line up with any number of the D scale. Consequently, we use the right index of the C scale and place it over 4 on the D scale. Then place the hair line over 7 on the C scale and read the answer, 28, on the D scale.



Example 3. Multiply: 3.26×15.8

We can see that the answer is approximately $3 \times 16 = 48$. Set the left index of the C scale above 3.26 approximately on the D scale. Place the hair line over 15.8 on the C scale and read 515 on the D scale. Since the answer is approximately 48, the result is 51.5.

Example 4. Find the circumference of a circle whose radius is 280.

Since $C = \pi D$, $C = \pi \times 560$.

Set the right index of the C scale above π on the D scale. Place the hair line over 560 on the C scale and read 176 on the D scale. Since $3 \times 600 = 1{,}800$ the answer is 1,760.

Solve the following problems:

	Problem	Answer
1)	5×12	60
2)	8.3×27	224
3)	257×31.3	8040
4)	0.0753×6.27	0.472
5)	Find the circumference of a circle whose radius is 52.	327

Example 5. Divide: $6 \div 2$

Remember, to divide two numbers we subtract their logarithms. Therefore, to divide 6 by 2, place the 2 on the C scale above the 6 on the D scale, and read the answer, 3, on the D scale under the index (left index in this case) of the C scale.

Example 6. A column of mercury 76 in. in height exerts a pressure of 1030 grams per sq. in. Find the density of mercury. $P = hd$, or $d = \frac{P}{h}$. Place the 76 on the C scale above the 1030 on the D scale, and read 136 on the D scale under the index (right) of the C scale. Since $1{,}000 \div 100 = 10$, the answer is 13.6 grams per cubic centimeter.

Problem		Answer
6)	$24 \div 6$	4
7)	$7.26 \div .183$	39.7
8)	$8570 \div .219$	39,100
9)	Find the diameter of a circle where the circumference is 100.	31.8
10)	A column of mercury exerts a pressure of 250 grams per sq. cm. How high is the column, if the density of mercury is 13.6 grams per cubic centimeter?	18.4 Cm.

One method of determining the position of the decimal point is by approximating the answer. Another method is to express the answer in scientific notation. When it is said that the distance from the earth to the moon is approximately 240,000 miles, the 2 and 4 are considered significant digits, since they were actually obtained by some measuring device. The zeros are not significant since they were not obtained experimentally, but were merely used to place the decimal point. As a matter of fact, the last three zeroes can be any digit (the distance of the earth from the moon ranges from 252,700 miles to 221,500 miles). To write 240,000 in scientific notation, we place a decimal point to the right of the first significant digit and multiply the number by an appropriate power of 10. $240,000 = 2.4 \times 10^5$

Similarly:

$3850 = 3.85 \times 10^3$
$3.85 = 3.85 \times 10^0$
$.385 = 3.85 \times 10^{-1}$
$.00385 = 3.85 \times 10^{-3}$

The exponent of the 10 corresponds to the characteristic of the logarithm of the number. If we express numbers in scientific notation, we can determine the position of the decimal point by remembering that we add the exponents in multiplication and subtract them in division.

Example 7.

a) Multiply 326×15.8

$$(3.26 \times 10^2) \times (1.58 \times 10^1) = 5.15 \times 10^3 = 5150$$

(Remember, when you multiply a number by 10^3 you move the decimal point 3 places to the right. When you multiply a number by 10^{-3} (or divide the number by 10^3), you move the decimal point 3 places to the left.

b) Divide 32.6 by 15,800

$$(3.26 \times 10^1) \div (1.58 \times 10^4) = 5.15 \times 10^{-3} = 0.00515$$

c) Multiply 0.0326 x 1.58

$$(3.26 \times 10^{-2}) \times (1.58 \times 10^0) = 5.15 \times 10^{-2} = 0.0515$$

Combined multiplications and divisions can be easily performed.

Example 8.

Multiply 1.4 x 2.1 x 30

1) Set the hair line at 14 of the D scale.
2) Move the index of the C scale under the hair line. Move the hair line over 21 on the C scale. (The product 2.94 could be read under the hair line on the D scale, but this is not necessary).
3) Move the index of the C scale under the hair line.
4) Move the hair line over 30 on the C scale.
5) Read the answer (88.2) on the D scale.

The process can be repeated for any number of factors.

Example 9. $\frac{1.4 \times 4.2}{30}$

1) First divide 1.4 by 30 by placing 30 on the C scale above 14 on the D scale.
2) Move hair line to 42 on the C scale. Read 196 on the D scale.
Answer is 0.196. If the problem were $\frac{1.4 \times 2.1}{30}$, and the rule were set to divide 14 by 30, the hair line when set over 21 would not be over the D scale.

Consequently, we proceed as follows:

1) Place 30 on the C scale above 14 on the D scale.
2) Move the hair line above the right index of the C scale.
3) Move the slide to the right so that the left index of the C scale is under the hair line. (This step merely corresponds to changing from one index of the C scale to the other, as was done in Example 2).
4. Move the hair line to 21 on the C scale and read 98 on the D scale.
Answer is 0.098

The process can be extended for a series of multiplications and divisions.

Problem		Answer
11)	$0.75 \times 3.4 \times 290$	739
12)	$\frac{3.14 \times 180}{1.25}$	452
13)	$\frac{12.5 \times 5.17 \times 93.3}{1.25}$	4,820
14)	Find the area of a circle if the radius is 120.	45,200 square units
15)	How many pounds of air are in a room 15' x 22' x 12' if one pound of air occupies 13.5 cubic feet?	293 pounds

Proportions can be solved simply and directly by the C and D scales. Since the C and D scales are logarithmic, if $\frac{a}{b} = \frac{c}{d}$, log a-log b = log c- log d. The last equation tells us, for example, that if we place the left index of the C scale over 2 of the D scale, the numbers 2, 3, 4, etc. of the C scale will be over the numbers 4, 6, 8 etc. of the D scale. In each case the ratio will be 1:2.

Example 10.

Solve the proportion $\frac{4}{6} = \frac{18}{x}$ for x.

Place the 6 on the C scale over the 4 on the D scale.

Over 18 on the D scale read 27 on the C scale.

Example 11.

How many grams of mercury would be obtained by reducing 500 grams of mercuric oxide?

$2HgO = 2Hg + O_2\uparrow$

The atomic weight of oxygen is 16 and the atomic weight of mercury is approximately 200.

$$\frac{500}{x} = \frac{432}{400}$$

Place 400 on the C scale over 432 on the D scale. Over 500 on the D scale read 463 on the C scale.

Problem		Answer
16)	Solve for x: $\frac{8}{x} = \frac{6}{9}$	12
17)	Solve for x: $\frac{2.8}{3.5} = \frac{x}{4.7}$	3.8
18)	The perimeters of similar triangles are proportional to the corresponding sides of the triangles. The perimeter of a triangle is 128 and one side is 52. Find the corresponding side of a similar triangle if its perimeter is 260.	106
19)	The diameters of the two pistons of a hydraulic press are 2 in. and 40 in. What force must be exerted on the small piston to lift a weight of 200,000 pounds on the large piston?	500 pounds
20)	How many grams of zinc are necessary to react completely with 120 grams of hydrochloric acid? ($Zm + 2HCl - H_2\uparrow + ZnCl_2$)	107 grams

Chapter III - Other Scales

1) The A and B scales.

The A and B scales are used to find square roots and squares of numbers. To find the square root of a number, place the hair line over the number on the A scale and read the square root of the number under the hair line on the D scale.

Since $\log \sqrt{N} = 1/2 \log N$, the A scale is one-half as large as the D scale and is printed twice. Consequently, to find the square root of numbers between 1 and 10, use the left part of the A scale, and to find the square root of numbers between 10 and 100, use the right part of the A scale. The process can be generalized as follows: To find the square root of a number with an odd number of digits at the left of the decimal point, use the left side of the A scale. To find the square root of a number with an even number of digits use the right side of the A scale. The same operations can be performed by using the B with the C scale.

Example 12. Find $\sqrt{9}$

Place the hair line over the 9 on the left part of the A scale and read the answer 3, on the D scale.

Example 13. Find $\sqrt{49}$

Place the hair line over the 49 on the right side of the A scale and read the answer 7, on the D scale.

Example 14. Find $\sqrt{4.9}$

Place the hair line over the number 49 on the left side of the A scale and read 22 on the D scale.
The answer is 2.2.

If the number is less than unity, count off the digits in pairs (as in finding square root by arithmetic).

Example 15. Find $\sqrt{.073}$

Since $.073 = \sqrt{.0730}$, we place the hair line over 73 on the left side of the A scale and read 27 on the D scale.
The answer is .27

To find the square of a number, reverse the process. Set the hair line over the number on the D scale (or C scale) and read the answer under the hair line on the A scale or B scale.

Example 16. $(2.6)^2$

Place the hair line over 26 on the D scale and read 676 under the hair line on the A scale. Answer is 6.76.

	Problem	Answer
21)	$\sqrt{29}$	5.4
22)	$\sqrt{290}$	17
23)	$\sqrt{.029}$	.17
24)	$(8.3)^2$	69
25)	$(.145)^2$	.021

(2) -- The K Scale

The K scale is used to find cube roots and cubes of numbers

in the same way that the A scale is used to find square roots and squares of numbers. To find the cube root of a number, place the hair line over the number on the K scale and read the cube root of the number under the hair line on the D scale. Since $\log \sqrt[3]{N} = 1/3 \log N$, the K scale is only 1/3 as large as the D scale and is printed 3 times. Thus, to find the cube root of a number between 1 and 10 use the left third of the K scale. To find the cube root of a number between 10 and 100 use the middle third, and to find the cube root of a number between 100 and 1,000 use the right third of the K scale. If the number is less than unity, to find its cube root, group the digits by threes.

Example 17. Find $\sqrt[3]{8}$

Place the hair line over 8 on the left third of the K scale, and read the answer 2 on the D scale.

Example 18. Find $\sqrt[3]{80}$

Place the hair line over 8 on the middle third of the K scale and read 43 on the D scale. Answer is 4.3.

Example 19. Find $\sqrt[3]{.8}$

Since $.8 = .\overline{800}$, place the hair line over 8 on right third of the K scale and read 9 on the D scale. Answer is .9.

	Problem	Answer
26)	$\sqrt[3]{.68}$	4.1
27)	$\sqrt[3]{680}$	8.8
28)	$\sqrt[3]{.68}$	.88

3) The CI and DI Scales

The CI and DI scales are the same as the C and D scales, except that the former scales read from right to left, while the latter read from left to right. Therefore the numbers on the CI and DI scales are reciprocals of the numbers on the C and D scales. Notice that when the hair line is placed anywhere on the rule, the numbers under the hair line on the D and DI scale are such that their product is unity. The use of the CI scale is illustrated by the following example.

Example 20. $\dfrac{26}{5.8 \times 3.2}$

Place the number 58 on the C scale over 26 on the D scale. Move the hair line to 32 on the CI scale and read the number 14 on the D scale. Answer is 1.4.

4) The CF and DF Scales

The CF (or DF) scale is identical with the C (or D) scale, except that the CF (or DF) scale begins with π . The advantage in using the CF scale is that it avoids resetting the slide.

Example 21. 2.8×6.4

Set the left index of C over 2.4 on D. The hair line can not be moved over 6.4 on the C scale. Therefore, it is moved over the 6.4 on the CF scale and the number 18 is read on the DF scale.

Another advantage in using the CF scale is the fact that C = D and $\log C = \log \pi + \log D$. Thus, the circumference of a circle can be found directly by placing the hair line over the number that represents the diameter on the D scale and reading the number that represents the circumference on the DF scale.

Example 22. Find the circumference of a circle whose diameter is 3.5.

Place the hair line over 35 on the C scale and read 11 on the CF scale. Circumference of the circle is 11.

5) The L Scale

The L scale is used to find the logarithm of a number. You locate a number on the D scale and find its logarithm on the L scale by using the hair line. The L scale gives the mantissa of the logarithm. The characteristic must be supplied by the student.

Example 23. Find log 23

Place the hair line over 23 on the D scale and read 36 on the L scale. Since the characteristic is 1, the answer is 1.36.

If the numbers were 2.3, the answer would be 0.36
If the numbers were 230, the answer would be 2.36
If the numbers were .023, the answer would be 8.36-10

The characteristic can be determined by writing the number in scientific notation. The exponent of 10 is the characteristic. Thus:

$23 = 2.3 \times 10^1$	Characteristic is 1
$2.3 = 2.3 \times 10^0$	Characteristic is 0
$230 = 2.3 \times 10^2$	Characteristic is 2
$.023 = 2.3 \times 10^{-2}$	Characteristic is -2 or 8-10

Note: Where the L scale on the slide reads from right to left, invert the slide so that the L scale reads from left to right. Place the hairline over your number on the D scale, invert the slide rule and find corresponding logarithm on the L scale.

6) The S and T Scales

The S and T scales are used to find the sine and tangent of an angle. The cosine and cotangent can also be found by using the relations: $\cos x = \sin (90-x)$ and $\cot x = \tan (90-x)$ or $\cot x = \frac{1}{\tan x}$. Notice that the scale starts at approximately $5^\circ 45'$ and the divisions vary from degree to degree and also are different for the S scale and the T scale. The S scale goes up to 90° but the T scale goes up to 45°. To find the tangent of an angle more than 45°, find the tangent of its complement and use the reciprocal of the result. This is based on the fact that $\tan x = \frac{1}{\cot x} = \frac{1}{\tan (90-x)}$. If the DI scale is used with the T scale, it is not necessary to find the reciprocal of $\tan (90-x)$. If the left indices of the C and D scales coincide, the log of a trigonometric function can be read directly from the L scale.

Example 24. Find a) $\sin 21^\circ$, b) $\cos 21^\circ$, c) $\tan 21^\circ$, d) $\cot 21^\circ$.

a) Place the hair line above 21° on the S scale. Read 36 on the C scale: $\sin 21^\circ = .36$. Remember that the sine and cosine of an angle between 0° and 90° are less than unity. The tangent of an angle between 0° and 45° is less than unity and between 45° and 90° is greater than unity. The cotangent of an angle between 0° and 45° is more than unity and between 45° and 90° is less than unity.

b) Since $\cos 21^\circ = \sin 69^\circ$, place the hair line over 69° on the S scale and read 93 on the C scale: cosine $21^\circ = .93$.

c) Place the hair line over 21° on the T scale and read 38 on the C scale; $\tan 21^\circ = .38$.

d) Since $\cot 21^\circ = \frac{1}{\tan 21^\circ}$ place the hair line over 21° on the T scale and read 26 on the DI scale. (Make sure the left indices of the C and D scales coincide). $\cot 21^\circ = 2.6$. Remember that the cotangent of an angle between 0° and 45° is greater than unity.

Example 25. Find $\log \sin 30^\circ$

Place the hair line over 30° on the S scale. Read 7 on the L scale. $\log \sin 30^\circ$ - 9.70-10 (The characteristic is -1).

Problem		Answer
29)	sin 41^o	.66
30)	cos 41^o	.75
31)	tan 41^o	.87
32)	cot 41^o	1.2
33)	log sin 63^o	9.95-10
34)	log cos 63^o	9.66-10
35)	log tan 63^o	0.29
36)	log cot 63^o	9.71-10
37)	Find x if sin x = .36	21^o
38)	Find x if cos x = .82	35^o
39)	Find x if tan x = 1.15	49^o
40)	Find x if cot x = .91	48^o
41)	Find x if log cos x = 9.61-10	66^o

7) Combined operations

We have now completed the discussion of the basic scales found in a slide rule. The different operations can be combined in such a way that only the final answer need be written. A few exercises will illustrate the principle. However, as you practice using the slide rule, you will become familiar with the full power of this instrument. Knowing the theory, you should be able to discover new procedures for shortening mathematical computations.

Example 26. Find the area of a parallelogram whose sides are 42 and 86 and whose included angle is 42^o. The formula for the area of a triangle is ab sin C. Therefore A = 42 x 86 x sin 42^o.

You can multiply 42 x 86 in the manner explained in Chapter II. The answer will be 3600. Sin 42^o can be found, as previously explained, to be .67. You can then multiply 3600 by .67 to obtain the answer 2400.

However, all these steps can be combined as follows:

1) Place the right index of the C scale over 42 of the D scale.
2) Move the hair line over 86 of the C scale.
3) Move the right index of the C scale to the hair line (above 36 of the D scale)
4) Place the hair line over 42^o on the S scale.
5) Read 24 under the hair line on the D scale.
   Answer is 2400.

In solving this group of problems try to keep the number of intermediate answers you write down to a minimum.

	Problem	Answer
42)	$\frac{\sqrt{58.5}}{.396}$	19.3
43)	$\frac{26 \times 72}{(31)^3}$	.063
44)	The area of an equilateral is given by the formula, $A = \frac{S^2\sqrt{3}}{4}$. Find the area of an equilateral triangle if one side equals 25.	270
45)	Find a side of an equilateral triangle where the area is 48.	11
46)	Find the radius of a circle whose area is 126.	6.3
47)	How tall is a building if it casts a shadow 82 ft. long when the angle of elevation of the sun is 68^o?	200 ft.
48)	If A, B, C are the angles of a triangle, and a, b, c, the sides opposite these angles respectively, then $\frac{a}{b} = \frac{\text{Sin } A}{\text{Sin } B}$. Find a, if b = 124, A = 52^o, and B = 30^o.	195
49)	The "pendulum formula" is $T = 2\pi\sqrt{\frac{L}{g}}$ where T is the time for a complete swing, L is the length of the pendulum and g is the acceleration due to gravity. Find T if L = 100 cm. and g = 980 cm./sec.^{2}.	2 sec.
50)	Boyle's Law states that the pressure of a confined gas varies inversely as the volume, provided the temperature is constant. $\frac{P_1}{P_2} = \frac{V_2}{V_1}$ (T constant).	

Problem	Answer
50) If 28 cu. ft. of a gas exerts a pressure 17 lbs. /sq. in., what pressure would be exerted by the gas if the volume were reduced to 12 cu. ft. and the temperature remained constant?	40 lbs./sq.in.
51 The general gas law states that for an ideal gas: $PV = RT$, where R is a constant for a given mass of gas used and T is the absolute temperature ($T^o = 273^o + C^o$). The formula can also be written in the form $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ A gas is compressed from 30 cc., to 3 cc., its temperature rising from 20° to 50°C. If its original pressure was 1 atmosphere, what is the final pressure?	11 atmospheres
52) How many grams of oxygen are there in 350 grams of sodium hydroxide (NaOH). Atomic weight of sodium is 23. Atomic weight of oxygen is 16. Atomic weight of hydrogen is 1.	140 grams
53) Avogadro's number (N_o) = 6×10^{23} It is the number of molecules of any gas at 0°C at atmospheric pressure in 22.4 liters. (The volume occupied by 1 mole of the gas.) One mole of H_2 weighs 2 grams. Find the weight of a molecule of H_2.	3.3×10^{-24} grams
54) Kepler's third law of planetary motion implies that the squares of the periods of two satellites are proportional to the cubes of their distances from the earth, that is: $\frac{t_1^2}{t_2^2} = \frac{d_1^3}{d_2^3}$	

Problem | Answer

54) Using the fact that the period of the moon is 28 days and that the distance of the moon from the earth is 60 times the radius of the earth, find the period of a satellite revolving close to the earth's surface. Use the proportion

$$\frac{(28)^2}{x^2} = \frac{(60)^3}{(1)^3}$$

1.5 hrs.

55) The theory of relativity states that the energy equivalent of a given mass is expressed by the formula $E = mc^2$, where c is the velocity of light (3×10^{10} cm/sec.) Find the energy equivalent of 5 kilograms (5,000 grams) of uranium.

$4.5 \times 10^{24}\ \frac{\text{gm-cm}^2}{\text{sec.}^2}$

56) Another prediction of the theory of relativity is known as the "relativistic" increase in mass with velocity. If an object has a "rest" mass m and has a velocity v, relative to an observer, its mass m as measured by that observer is

$$M = \frac{M_o}{\sqrt{1 - \frac{V^2}{C^2}}}$$

The rest mass of an electron is $m_0 = 9.1 \times 10^{-28}$ gms. If an electron is accelerated to a velocity of .95c, what would be the value of m.

2.9×10^{-27} gms.

57) The wave length of an "electron wave" is given by the formula $\lambda = \frac{h}{m_o v}$

h (Planck's constant) = 6.6×10^{-27} erg-sec.
m_o (the rest mass of an electron) = 9.12×10^{-28} gms.
v is the velocity of the electron

Find the "wave length" of an electron moving with a velocity of 6.0×10^{8} cm/sec.

1.2×10^{-7} cm